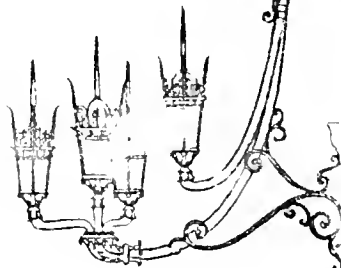




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Basic Design Analysis

March 1987

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# Herald Street Improvements

Boston, Massachusetts



**CE MAGUIRE, INC.**

Architects • Engineers • Planners

60 First Avenue, Waltham, Massachusetts 02254


**THE MAGUIRE  
GROUP**

Soils, Right of Way & Consultation by FAY SPOFFORD & THORNDIKE INC.



MEMORANDUM

TO: Distribution

FROM: Owen Donnelly 

DATE: June 9, 1987

SUBJECT: Herald Street Feasibility Study

---

C.E. Maguire has been undertaking a study, under the direction of Bill Barbato, which examines alternative schemes for improving Herald Street. Modifications to Herald Street could have significant implications for the South End, Chinatown/South Cove, Bay village, and Back Bay. The study has reached a stage where review and discussion by BRA staff involved in the general area would be appropriate as the process moves toward identifying a preferred alternative. Accordingly, a presentation of the study has been scheduled for Tuesday, June 16, at 9:30am in the Planning Conference Room. Your participation in this meeting is encouraged.

Attached for your information is an executive summary of the draft study report.

Attachment

Distribution:

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REPORT ON THE  
BASIC DESIGN ANALYSIS  
FOR THE  
HERALD STREET IMPROVEMENTS

EXECUTIVE SUMMARY

This report presents the results of an on-going study to develop a Basic Design for roadway improvements along the Massachusetts Turnpike Corridor in the South End and South Cove Sections of Boston between Clarendon Street and Albany Street (see Figure 1).

The purpose of the improvements is to alleviate traffic congestion in the corridor and to encourage traffic onto the project corridor and off the local streets. The report also considers the relationships between the roadway improvements and possible future air-rights developments over the Turnpike and railroads to ensure that the two are compatible and will complement each other.

The report consists of basic design analysis of two alternatives for transportation improvements within the corridor, the "Two Way Herald" (see Figures 2A and 2B) and the "One Way Pair" (see Figures 4A and 4B). The report compares the two alternatives based on traffic analysis, construction cost, and air-rights development potential.

The "Two Way Herald" alternative proposes widening Herald Street between Albany Street and Arlington Street to provide two lanes of travel in each direction and provides an additional exclusive right turn lane for eastbound traffic at Albany Street. This alternative also proposes extending Herald Street as a two way, four lane divided roadway from its present terminus at Arlington Street to Columbus Avenue at Cahner Place by building a viaduct over the railroad and Turnpike. Presently Herald Street is one way eastbound from Arlington Street to Washington Street. This alternative includes the replacement of most of the existing retaining wall separating Herald Street and the railroad and the construction of a four lane viaduct over the railroad and part of the Turnpike between Columbus Avenue and Arlington Street.

The "One Way Pair" alternative proposes the extension of Herald Street to provide a one way eastbound roadway from Columbus Avenue to Albany Street, two lanes from Columbus Avenue to Arlington Street and three lanes from Arlington Street to Albany Street. To provide traffic flow in the opposite direction, Marginal Road and Broadway are extended to provide a one way westbound roadway between Albany Street and Berkeley Street, three lanes from Albany Street to Arlington Street and two lanes from Arlington Street to Berkeley Street. Together the two roadways provide a one way pair for the length of the corridor. This alternative includes the construction of a two lane viaduct over the railroad between Columbus Avenue and Arlington Street, the construction of a new three lane bridge over the railroad and Turnpike connecting Broadway and Marginal Road, the extension of Marginal Road to



Berkeley Street, the realignment of a Turnpike on-ramp off Arlington Street and the replacement or relocation of existing retaining walls.

It is our understanding that most of the foundation supports for the Herald Street viaduct under the Two Way Herald alternative and all the foundation support for the Herald Street viaduct under the One Way Pair alternative were provided under the MBTA's Southwest Corridor and South Cove Projects.

Both alternatives include an optional connector roadway which directs the Clarendon Street traffic to the Herald Street Extension. This connector roadway bisects a block bounded by Clarendon Street, Columbus Avenue, Cahner Place and Stanhope Street. It is our understanding that this block may be under consideration for development. The extent of this development is unknown and may include air-rights.

The MBTA is investigating various options for providing replacement service for the Washington Street Corridor. One option under consideration includes the closing of part of Marginal Road to traffic which would be incompatible with the One Way Pair Alternative.

Both alternatives include the construction of new or widened roadways above the MBTA and Massachusetts Turnpike right-of-way. Agreement will be required with the Massachusetts Turnpike Authority and the MBTA (to the satisfaction of Conrail and the Federal Railroad Administration) for the use of their air-rights. In addition to the air-rights agreements the following land takings will be required:

<u>Owner</u>	<u>Two Way Herald</u>	<u>One Way Pair</u>
Massachusetts Bay Transportation Authority	17,700 SF±	3,900 ±SF
Massachusetts Turnpike Authority		28,600 ±SF
Boston Herald	3,800 SF±	
John Hancock	1,400 SF±	
Tai Tung		1,100 ±SF

Numerous existing retaining walls adjacent to the railroad or Turnpike must be replaced under both alternatives. Many of these walls will be required for the support of any possible future air rights developments built over the Turnpike or railroads. A decision must be reached before design of the Herald Street improvements is started as to whether or not the design of the walls will include provisions for the support of the future possible air-right developments. A decision to include provisions for the future air-rights means the following questions must be answered: Which blocks will be developed? What amount of support will be required? How will this additional support be funded? A decision not to include provisions for the future air-rights may result in the replacement of some of these new walls and rebuilding portions of the adjacent roadways under the air-rights development project.

The One Way Pair alternative will provide the best access and circulation of traffic movements in and through the study area. The Two



Way Herald alternative services more vehicles than a No Build option, however, the average delay per vehicle per intersection is increased. The One Way Pair alternative services more vehicles while reducing the average delay per vehicle per intersection.

	<u>No Build</u>	<u>Two Way Herald</u>	<u>One Way Pair</u>
Vehicles Served (Corridor)	27,100	36,100	40,700
Ave. Delay Per Vehicle Per Intersection (Sec)	50	106	16
Intersections at Level of Service F	2	5	2*

The one way street patterns set up by the One Way Pair alternative eliminates left turn conflicts at most intersections thereby increasing the capacity of the system and reducing delays.

Future air rights can be developed under both schemes, however their construction will be somewhat simpler in some areas under the One Way Pair. The One Way Pair provides better access to the developments. Access to any future air rights under the Two Way Herald alternative should probably be restricted to Marginal Road. The estimated construction cost\*\* of the Two Way Herald alternative in 1986 dollars is \$11,600,000. The estimated construction cost of the One Way Pair alternative is \$13,400,000 (\$16,700,000 with recommended improvements at the Clarendon Street, Columbus Avenue and Herald Street, Arlington Street Intersections).

\* Zero with recommended improvements at the Clarendon/Columbus and Herald/Arlington intersections.

\*\* Costs do not include design costs land taking costs, air-rights costs and the cost of improving the water and sewer systems in the affected roadways.



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REPORT ON THE  
BASIC DESIGN ANALYSIS  
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HERALD STREET IMPROVEMENTS

INTRODUCTION

This report presents the results of an on-going study to develop a Basic Design for roadway improvements along the Massachusetts Turnpike Corridor in the South End and South Cove Sections of Boston between Clarendon Street and Albany Street (see Figure 1). The relationship between the roadway improvements and the development of the air-rights over the adjacent depressed Massachusetts Turnpike/Railroad right-of-way is also considered in the analysis.

The Boston Redevelopment Authority's goal in improving the transportation facilities in this corridor are as follows: to alleviate traffic congestion in the corridor; to encourage traffic onto the project corridor and off the local streets; to provide access to possible future air-rights developments. The transportation improvements have been evaluated with these goals in mind.

In recent years air-rights along the Massachusetts Turnpike Extension have been developed for the Prudential Center, the Hancock Garage and Copley Place. This report considers the relationships between possible future air-rights development and the roadway improvements to ensure that the two are compatible and will complement each other.

The report consists of basic design analysis of two alternatives for transportation requirements within the corridor, the "Two Way Herald" (see Figures 2A and 2B) and the "One Way Pair" (see Figures 4A and 4B). The report compares the two alternatives based on traffic analysis, construction cost, and air-rights development potential.



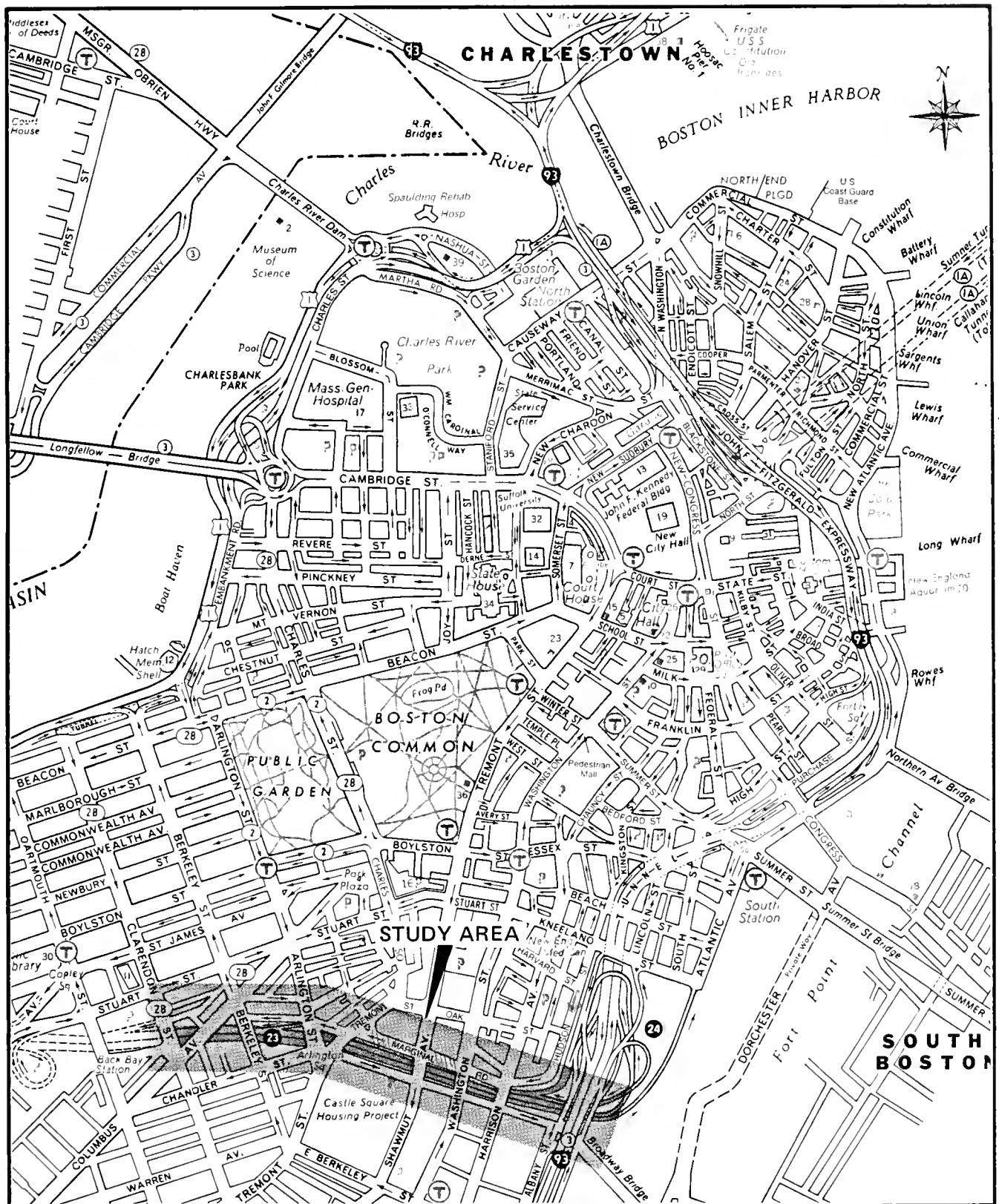


Figure 1  
Location Plan

Basic Design Analysis - Herald Street Improvements



## TRANSPORTATION IMPROVEMENTS

The "Two Way Herald" alternative proposes widening Herald Street between Albany Street and Arlington Street to provide two lanes of travel in each direction and provides an additional exclusive right turn lane for eastbound traffic at Albany Street. This alternative also proposes extending Herald Street as a two way, four lane divided roadway from its present terminus at Arlington Street to Columbus Avenue at Cahner Place by building over the railroad and Turnpike. Presently Herald Street is one way eastbound from Arlington Street to Washington Street.

The "One Way Pair" alternative proposes the extension of Herald Street to provide a one way eastbound roadway from Columbus Avenue to Albany Street, two lanes from Columbus Avenue to Arlington Street and three lanes from Arlington Street to Albany Street. To provide traffic flow in the opposite direction, Marginal Road and Broadway are extended to provide a one way westbound roadway between Albany Street and Berkeley Street, three lanes from Albany Street to Arlington Street and two lanes from Arlington Street to Berkeley Street. Together the two roadways provide a one way pair for the length of the corridor.

## MAJOR CONSTRAINTS

The many constraints that guided the development of the basic designs are as follows:

### . Vertical Clearances

The Massachusetts Turnpike Authority and the various railroad agencies (MBTA, Conrail, Amtrak) all have specific minimum vertical clearances (see Design Criteria in the Appendix) that





will dictate the minimum elevation of the Herald Street and Broadway Extensions and the first floor elevations of any future air-rights developments.

. Support Locations/Horizontal Clearances

For the Herald Street and Broadway Extensions as well as future air-rights developments to be constructed over the Massachusetts Turnpike and the railroad tracks, supporting columns, piers and abutments must be placed in areas not occupied by tracks, roadways, or other features that are not easily relocated. The Turnpike Authority and the various railroad agencies have established minimum horizontal clearances for their facilities that will dictate where the supporting elements may be located (See Design Criteria in Appendix).

→ It is our understanding that MBTA Southwest Corridor and South Cove Projects have made provisions for the support of the Herald Street Extension between Columbus Avenue and Arlington Street.

. MBTA Replacement Transit

The MBTA is investigating various options for providing replacement service for the Washington Street corridor after the Orange Line is relocated from Washington Street to the Southwest Corridor. One option under review is installation of Light Rail Vehicles (LRV's) on Washington Street. This option may result in the establishment of an area reserved for LRV's along the southerly edge of Marginal Road between Shawmut Avenue (or possibly Tremont Street) and Washington Street, and then south along the westerly edge of Washington Street. This option may require the closing of Marginal Road between Shawmut Avenue and Washington Street to all vehicular traffic except school buses. This option would affect the design of any possible future air-rights development in the corridor and have a significant



impact on traffic operations in this corridor. The closing of the Shawmut Avenue to Washington Street section of Marginal Road to traffic is incompatible with the "One Way Pair" alternative. The closing is feasible under the "Two Way Herald" alternative but hinders local traffic circulation and access to possible future air-rights developments.

#### . Groundwater Level

The groundwater level in the study area is less than two feet below the surface of the Turnpike and will have to be maintained at that level during construction. Changes in the groundwater elevation would have detrimental effects on the Turnpike roadway and all structures in the area that are supported on timber piles or caissons bearing on the clay layer.

#### . Soils/Foundations

The study area was filled in several stages during the mid-1880's and a typical section reveals that the surface material consists of ten to fifteen feet of granular fill on an equivalent amount of organic silt. Beneath the organic material is approximately one hundred feet of Boston Blue Clay. Between the cohesive clay layer and the Cambridge Argillite bedrock floor is a thin layer of till. In the Washington Street area the top layers of granular fill and organic silt decrease to zero because Washington Street is part of the original land mass of Boston.

Future structures built on air-rights would have to span the railroad and the Turnpike. The framing would be picked up by supporting elements along the line between Herald Street and Amtrak, along the line between the Amtrak and Conrail, along the line between Conrail and the Turnpike, along the center of the



Turnpike and along the northerly edge of the Turnpike. Column loads would probably be picked up on small footings and, because of the load concentrations at each column, will rest on piles most likely driven to bedrock.

#### . Restraints During Construction

While structurally feasible, construction on air-rights over the Turnpike, the MBTA tracks and Conrail tracks, will present problems during construction. Only one travel lane can be closed while working over the Turnpike. This is acceptable when driving piles and installing pile caps and columns in the Turnpike median. However, when framing or decking that spans the entire roadway is being installed, construction must be restricted to weekends and nights, thus increasing construction costs. This approach was utilized for the Copley Place project, which required a deck be constructed over active ramps and portions of the Turnpike. The railroads present a similar problem in that they must remain operational during construction, though, unlike the turnpike where traffic is constant, there are regular scheduled breaks in the railroad operations. New wall construction adjacent to Herald Street will impede traffic on this roadway.



## ANALYSIS OF TRANSPORTATION ALTERNATIVES

Two basic designs have been developed for transportation improvements in the corridor, the "Two Way Herald" and the "One Way Pair". Following is a brief description and review of the two schemes.

### . Two Way Herald

Herald Street is presently one way eastbound from Arlington Street to Washington Street and two way between Washington Street and Albany Street. The Two Way Herald scheme shown on Figures 2A and 2B consists of widening existing Herald Street between Arlington Street and Albany Street and making it a four lane, two way roadway. Also proposed is the extension of Herald Street as a four lane, two way divided roadway from its present terminus at Arlington Street to Columbus Avenue at Cahner Place. Stanhope Street would be widened and, together with Cahner Place, becomes a westbound connector between the Herald Street Extension and the Turnpike on-ramp and Hancock Garage on Clarendon Street.

The Herald Street Extension between Columbus Avenue and Arlington Street would be built on viaduct over the MBTA Orange Line and Conrail. It is our understanding that foundation supports for this section of the Herald Street Extension were provided along the line between Amtrak and the MBTA Orange Line and along the line between the MBTA Orange Line and Conrail under the MBTA Southwest Corridor and South Cove Projects. However, new foundations would be required between Conrail and the eastbound Turnpike Roadway (see Figure 3, Section E-E). Future possible air-rights would also require foundation support between Conrail and the eastbound Turnpike Roadway. If desired, supports for Herald Street Extension could be spaced in a way that provides for air-rights development supports to be installed between them in the future. A two foot safety walk is proposed for the southerly side of the roadway and a ten foot sidewalk for the





northerly side. A wide sidewalk is not required on the southerly side as this area abuts the vent of the station platform between Columbus Avenue and Berkeley Street and abuts the Amtrak rails between Berkeley and Arlington Streets.

The proposed intersection of two-way Herald Street with Arlington Street and Tremont Street would be a five legged intersection with traffic entering from all approaches. The existing intersection is four legged and traffic enters from three approaches. Previously this intersection was five legged but Chandler Street was closed as a through way.

Provisions for widening Herald Street for 300' east of Tremont Street were provided for under the MBTA South Cove Project. Widening of Herald Street from that point to Washington Street will probably require a new retaining wall just north of the existing retaining wall (see Figure 3 Section F-F). There should be adequate room between the proposed retaining wall and the Amtrak rails to allow supports for air-rights development. A two foot safety walk would be provided on the northerly side of Herald Street adjacent to the retaining wall. This sidewalk could be widened to a minimum of ten feet as part of a possible air-rights development. A ten foot sidewalk is proposed for the southerly side of Herald Street.

Between Washington Street and Harrison Avenue, Herald Street can be widened without building a new retaining wall, however, the space remaining to provide support for possible air-rights development is marginal. Air-rights supports could possibly be squeezed between the Amtrak rails and the existing retaining wall, or between Herald Street and the existing retaining wall depending upon the size of the supports and space available. In the worst case, if the air-rights are developed after Herald Street is widened, the wall may have to be replaced under the air-rights development project with one that can retain Herald Street and support the air-rights development. This may require



rebuilding part of Herald Street. Ideally, the Herald Street widening and the air-rights development occur concurrently and, if the wall needs to be replaced for the air-rights, it is replaced before or during the Herald Street widening.

The existing wall between Harrison Avenue and the railroad spur line would have to be replaced with a new wall. If desired, this wall could be designed to support future air-rights. The required widening of Herald Street between the spur line and Albany Street is minimal and can possibly be accomplished by canterlevering the sidewalk off the existing wall depending on the width of the required widening, the vertical clearance requirements and the construction of the existing wall. Further study is required to determine the feasibility of this approach. Future possible air-rights developments would likely require its replacement. The utility bridge east of the Harrison Avenue bridge would require major modifications since it occupies land required for the widening of Herald Street. Herald Street is widened on the southerly side to provide a right turn lane to accommodate the heavy right turn movement onto Albany Street. To provide room for the right turn lane while minimizing the loss of parking for the Herald building a retaining wall may be required. If the right turn lane is not built, the retaining wall will not be necessary.

The profile of the Herald Street Extension was not developed, but would be similar to the one developed for the One Way Pair scheme shown on Figure 5A.



The Two Way Herald scheme provides an eastbound link between Columbus Avenue and existing Herald Street. Expressway bound traffic on Clarendon Street originating in the Back Bay would turn left onto Columbus Avenue and right onto the Herald Street Extension. A more direct approach to the Extension would be desirable. Two possible solutions to this are shown on Figure 2A (Optional Roadway Connector, Alternatives B and C). With the exception of the right turn lane at Albany Street, the capacity of eastbound Herald Street between Arlington Street and Albany Street is not increased and the additional generated traffic will degenerate the Level of Service of the roadway.

Existing traffic travelling from Albany Street to Berkeley Street and the Back Bay Area turns right from a single westbound lane on Herald Street onto a three-lane Washington Street, then left onto a three-lane Marginal Road and finally accesses Berkeley Street on a one lane residential Cortes Street. The Two Way Herald scheme would allow the movement to stay on Herald Street to Berkeley Street and Columbus Avenue. Cortes Street and Marginal Road should experience a significant decrease in traffic volume.

*Left turn  
lane  
median*

Since the Two Way Herald scheme has no provision for separate left turn lanes, delays will be expected at intersections as a result of the additional approach lanes at each intersection as well as the left turning traffic holding up traffic in the through lanes. Separate left turn lanes and a median island would be desirable between Tremont Street and Albany Street but this would require an additional 18' of widening, almost exclusively over the railroad properties.

*Right turn  
lane  
median*

To minimize congestion on Herald Street under this scheme, vehicular access to future possible air-rights developments may best be limited to Marginal Road.



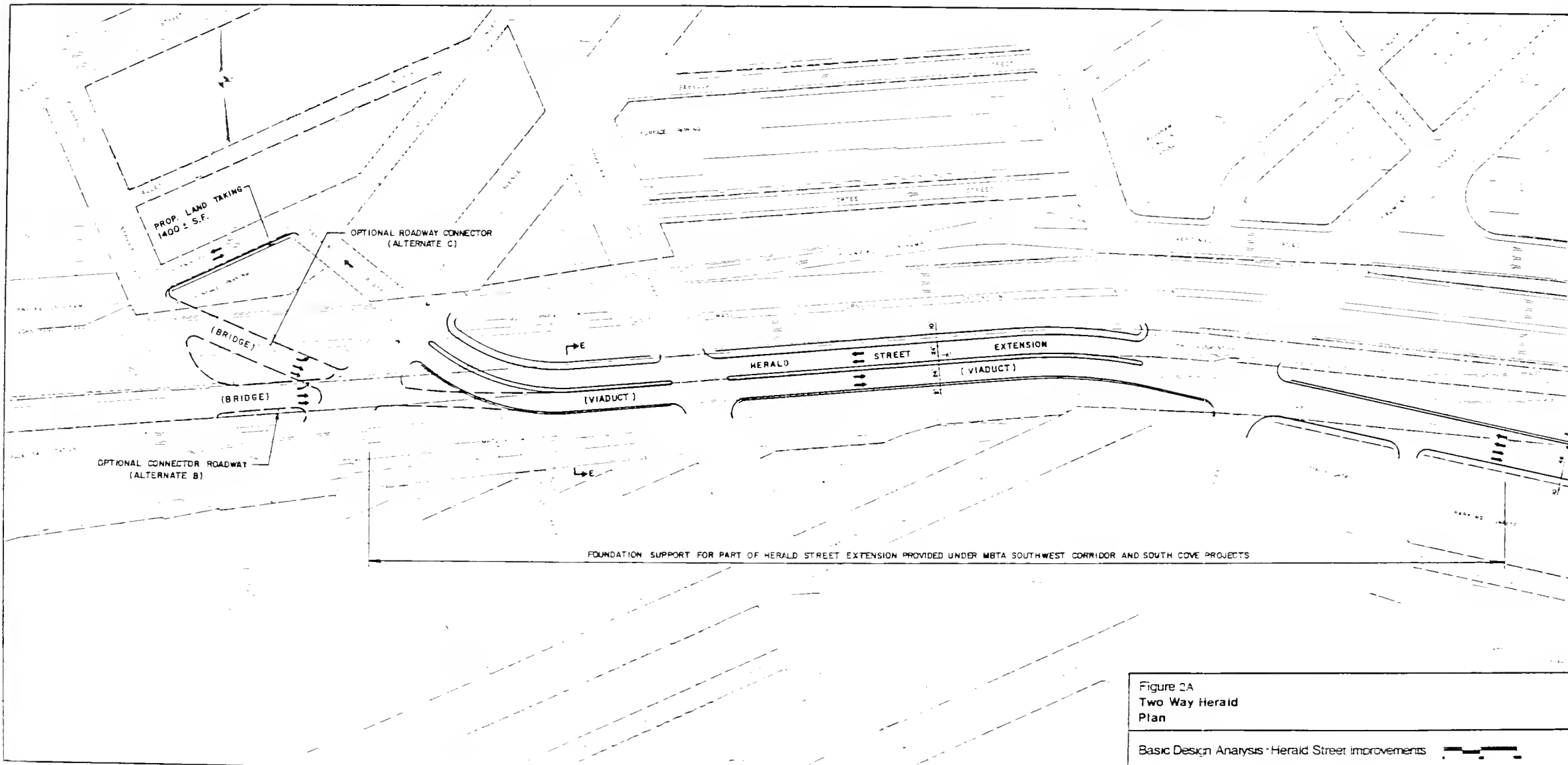


Figure 2A  
 Two Way Herald  
 Plan

Basic Design Analysis - Herald Street Improvements





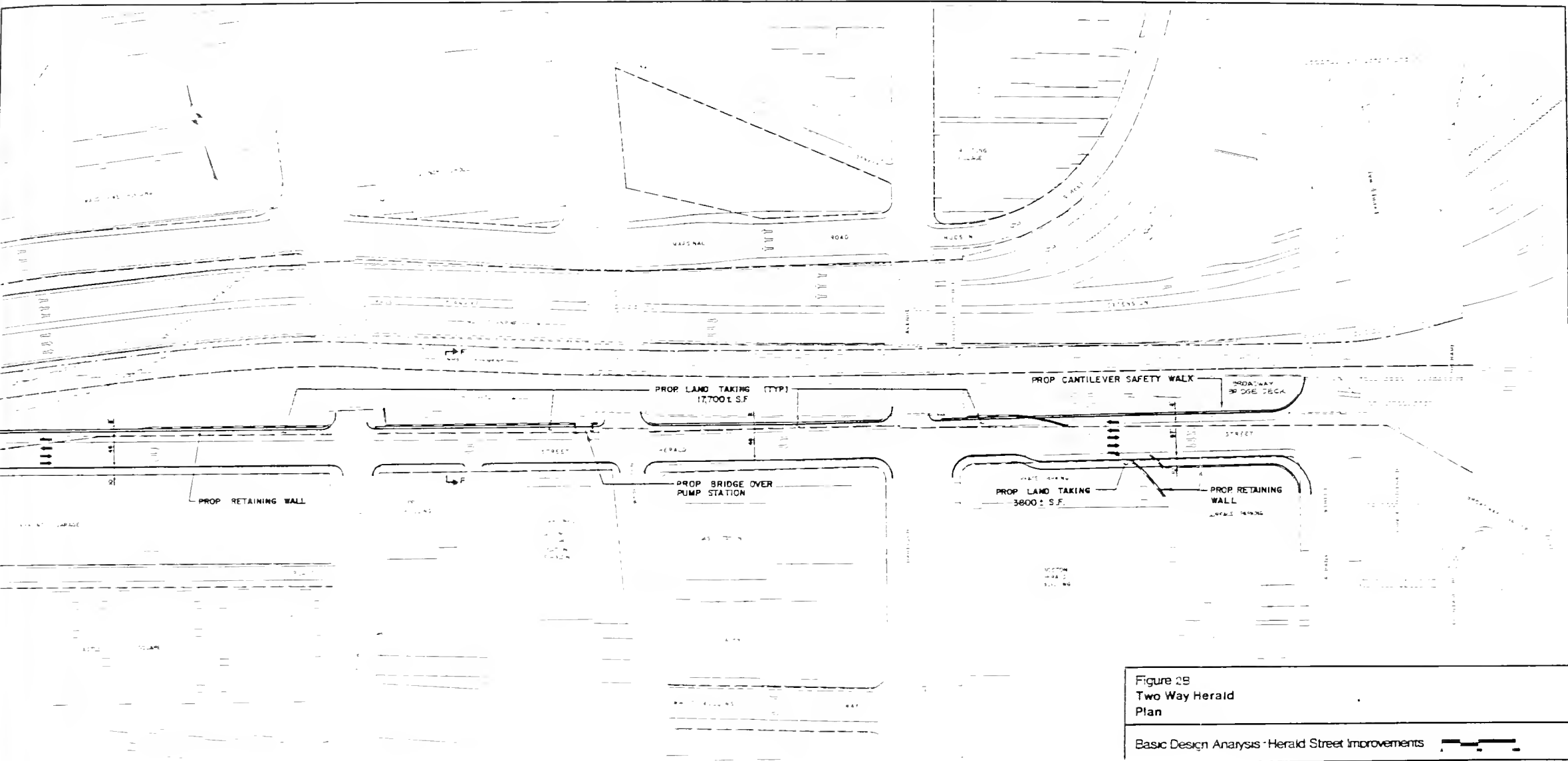
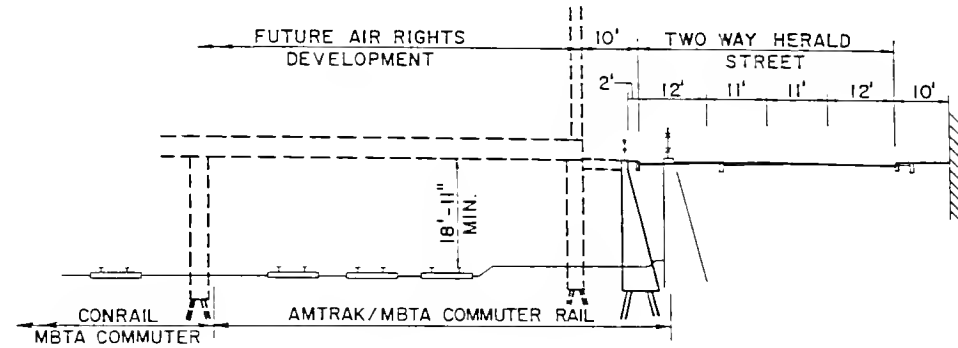


Figure 28  
Two Way Herald  
Plan

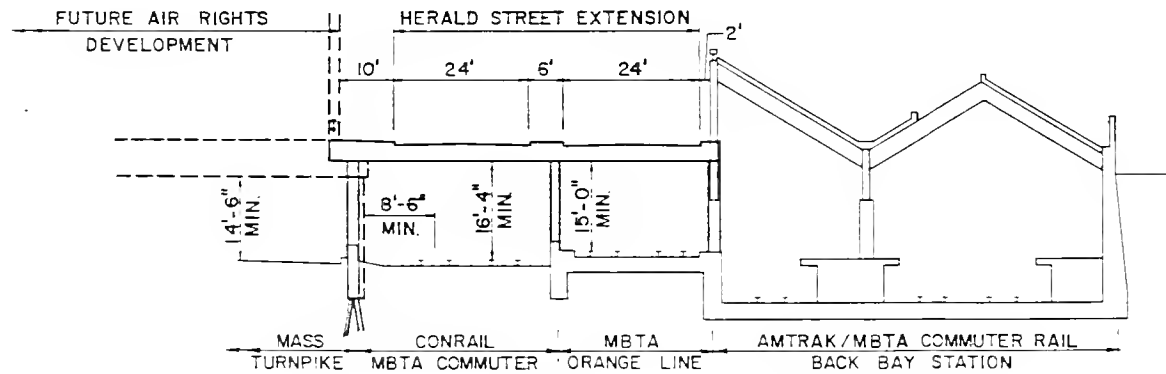
Basic Design Analysis - Herald Street Improvements







**HERALD STREET**  
SECTION F-F



**HERALD STREET EXTENSION**  
SECTION E-E

Figure 3  
Two Way Herald  
Typical Sections

Basic Design Analysis - Herald Street Improvements





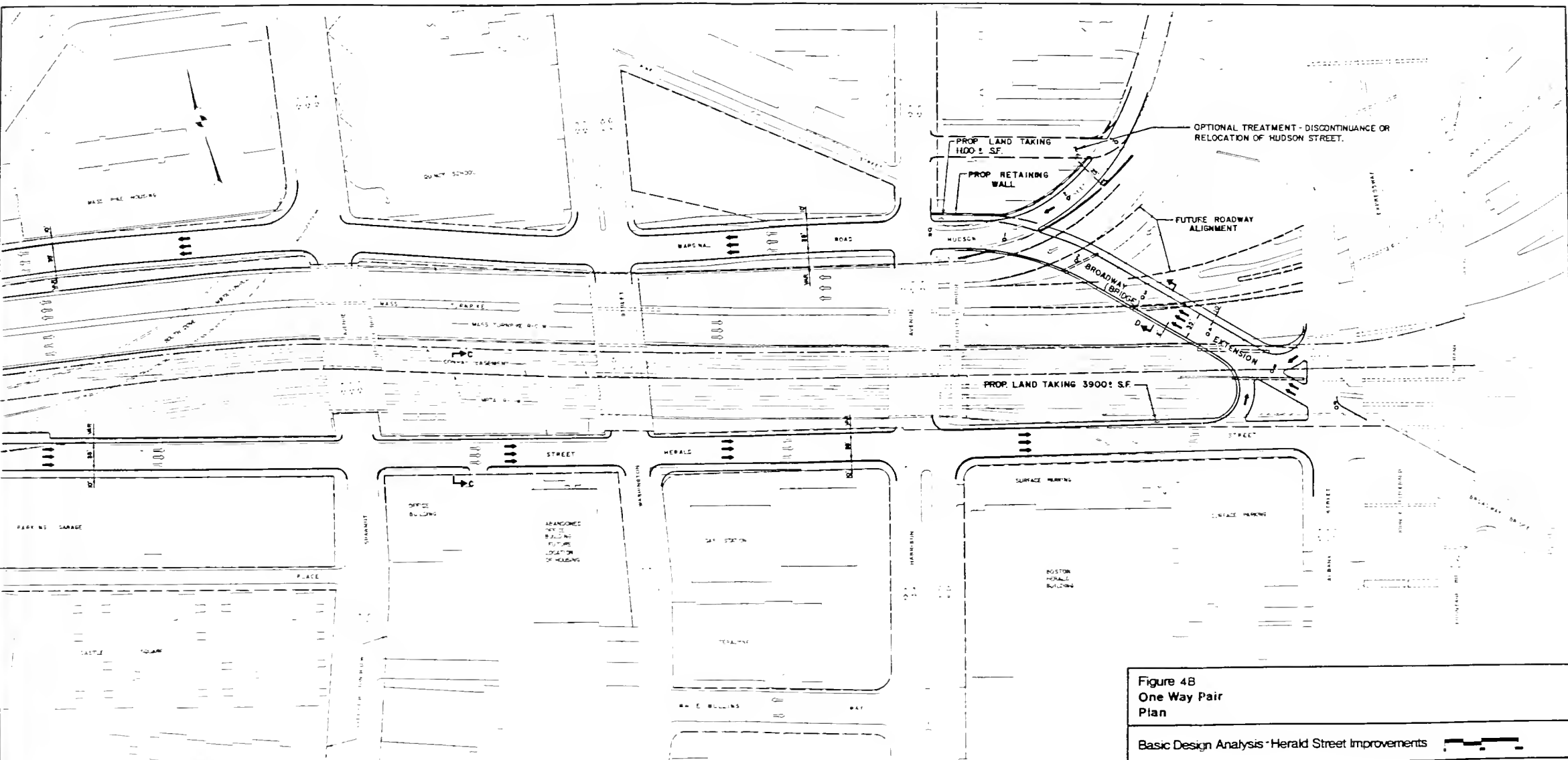


Figure 4B  
One Way Pair  
Plan

Basic Design Analysis - Herald Street Improvements





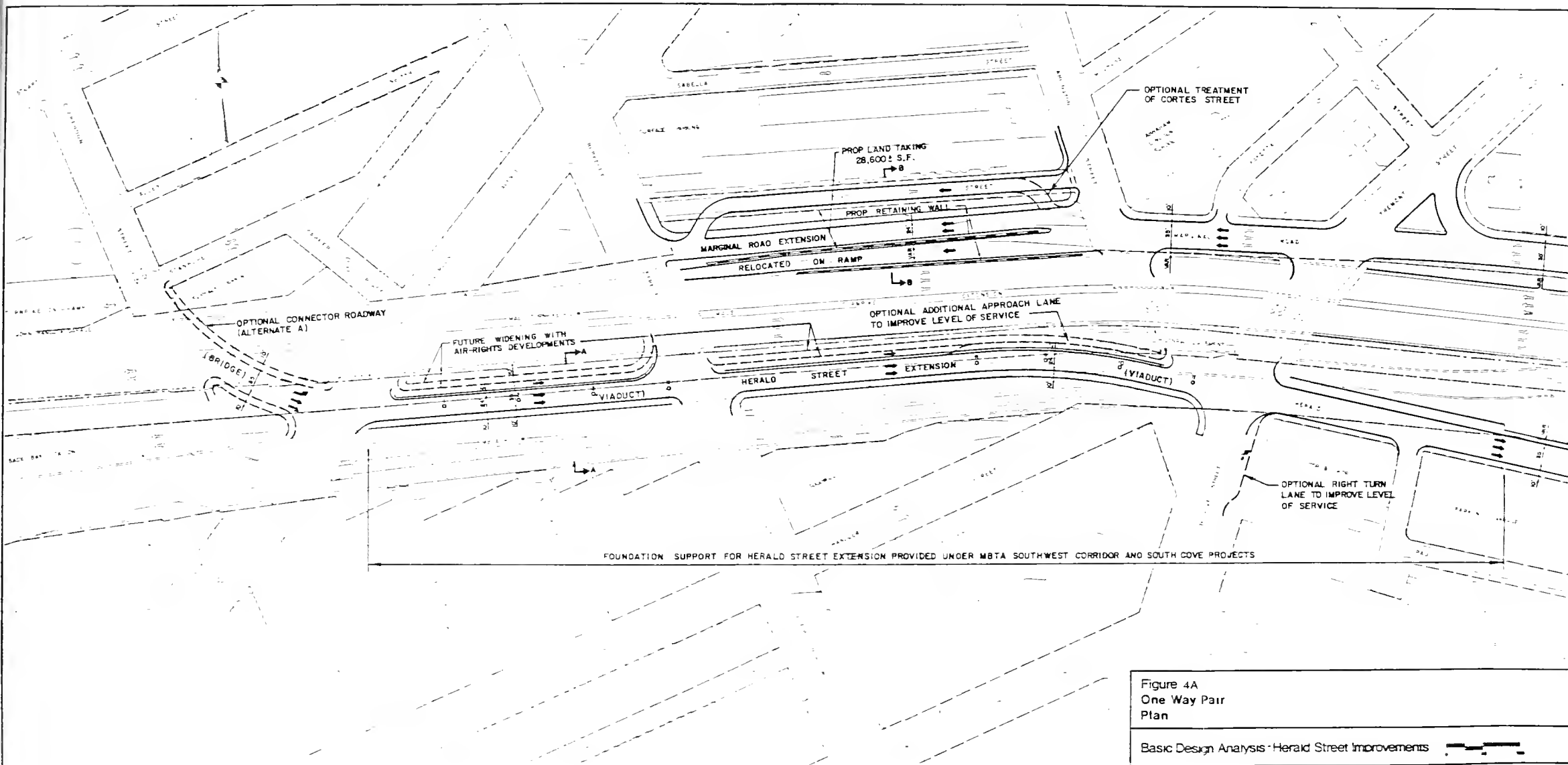
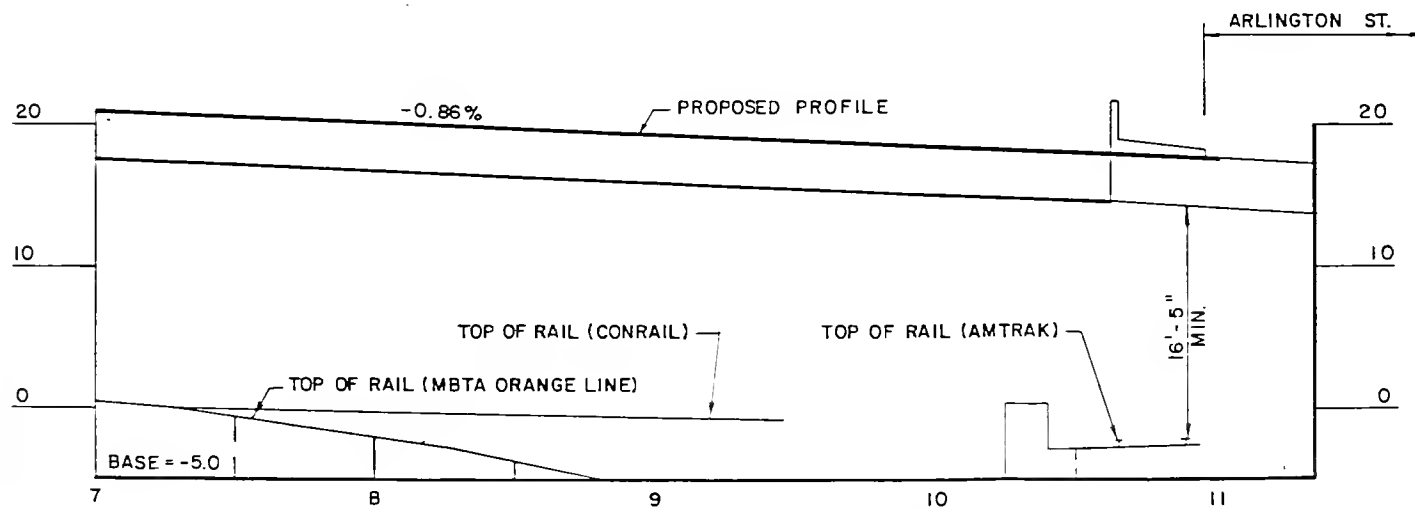
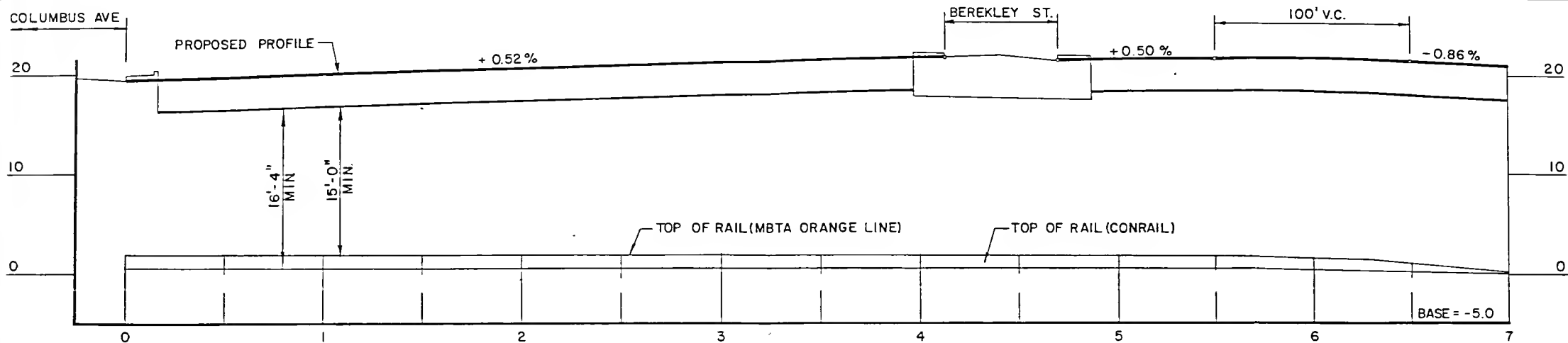


Figure 4A  
 One Way Pair  
 Plan  
 Basic Design Analysis - Herald Street Improvements







HERALD STREET EXTENSION

Figure 5A  
One Way Pair  
Profile

Basic Design Analysis- Herald Street Improvements





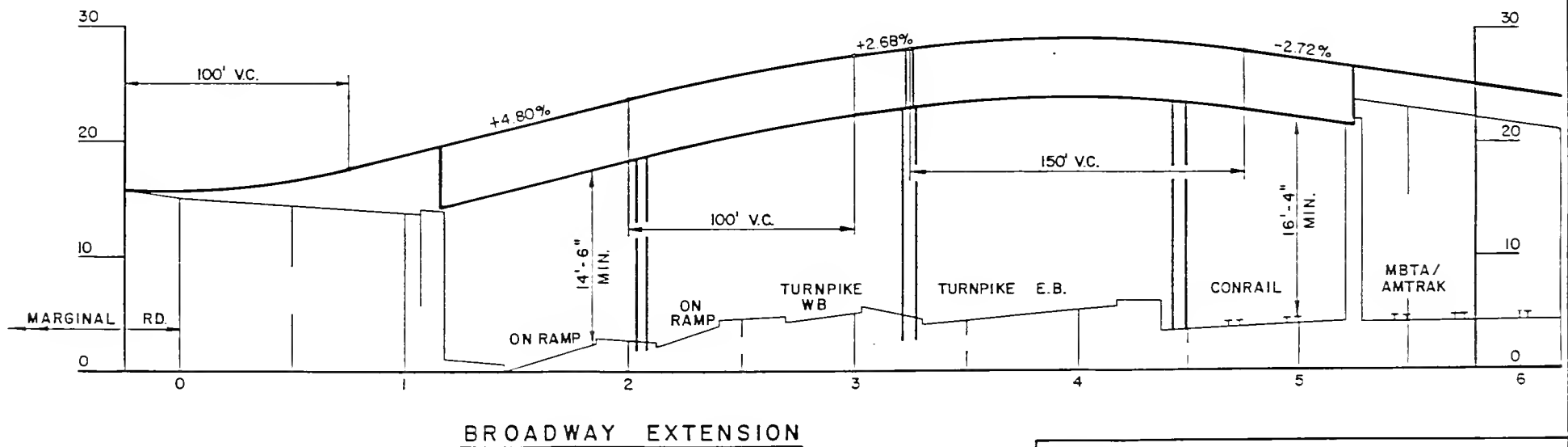
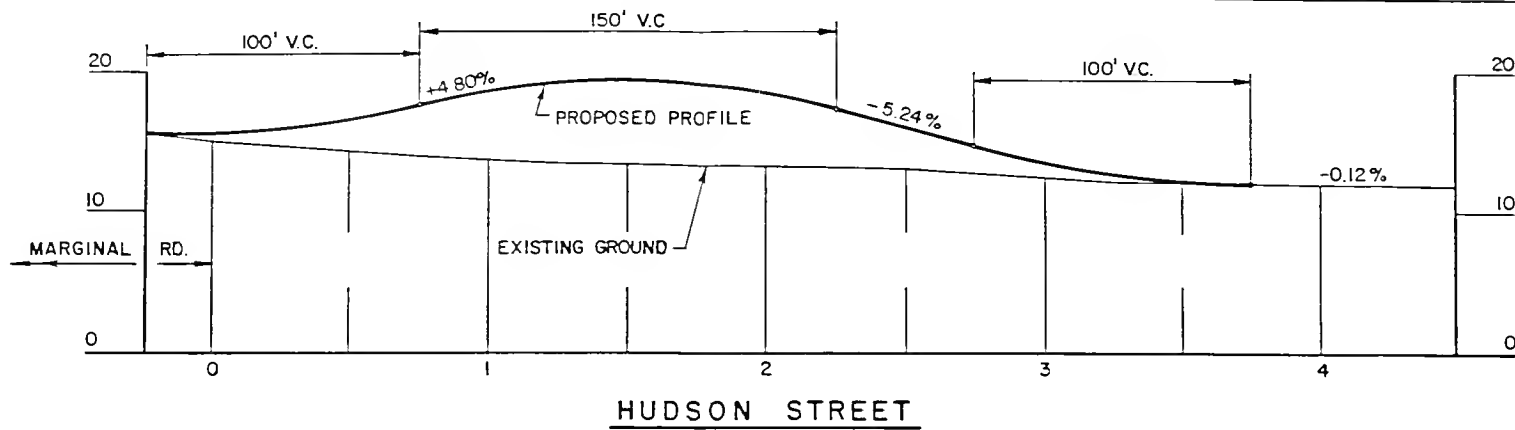
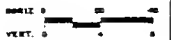
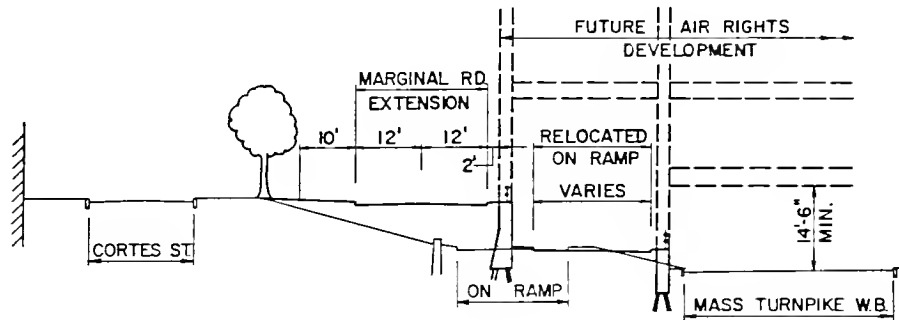


Figure 5B  
One Way Pair  
Profile

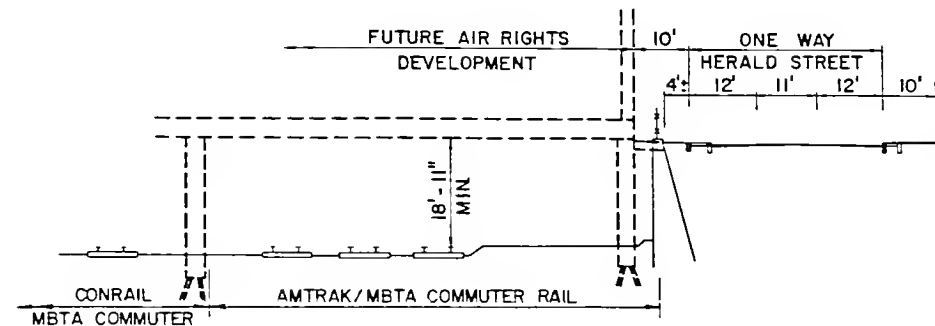
Basic Design Analysis - Herald Street Improvements



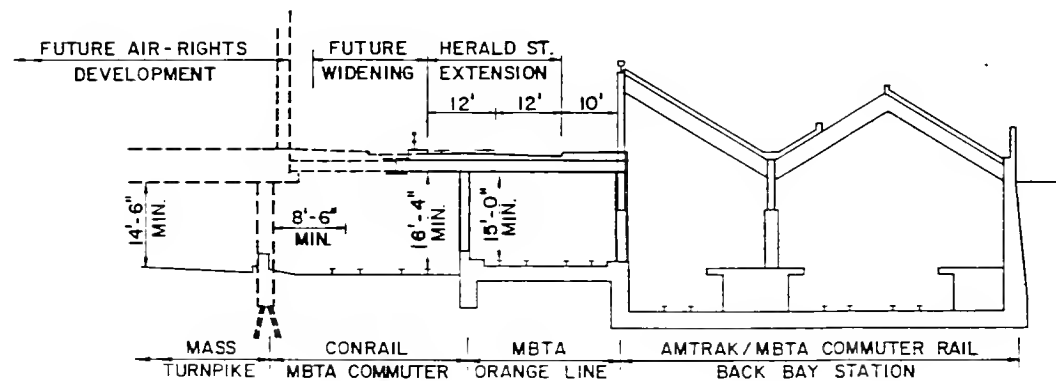




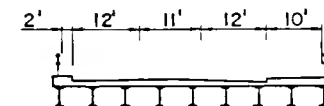
**MARGINAL ROAD EXTENSION**  
SECTION B-B



**HERALD STREET**  
SECTION C-C



**HERALD STREET EXTENSION**  
SECTION A-A



**BROADWAY EXTENSION**  
SECTION D-D

Figure 6  
One Way Pair  
Typical Sections

Basic Design Analysis - Herald Street Improvements





## Utilities Review

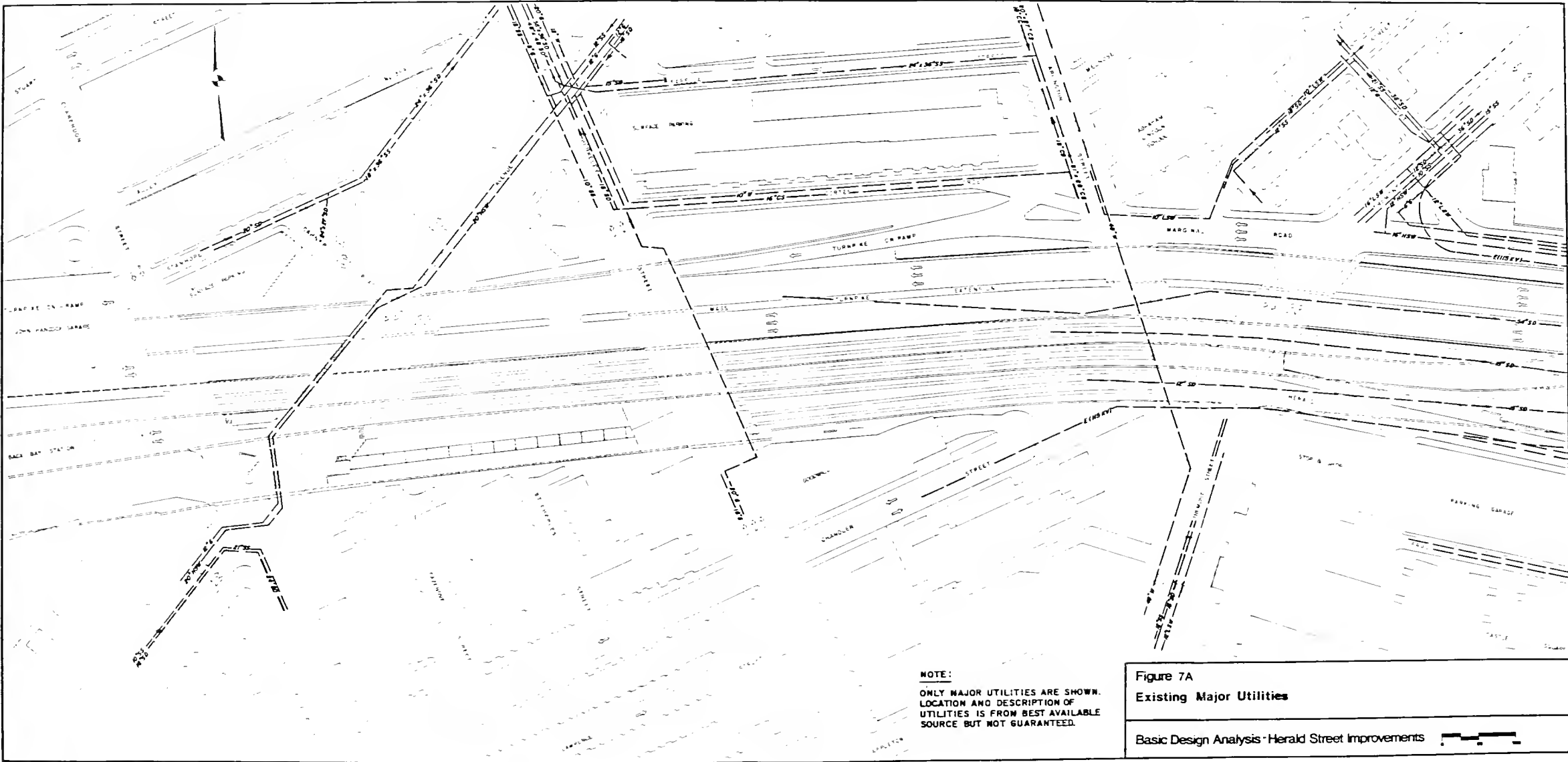
The major utilities within the project area are shown on Figures 7A and 7B. Since neither scheme calls for major changes to the profile or alignment of the existing roadways, most utilities will remain unaffected. Under the Two Way Herald scheme major modifications to the utility bridge east of the Harrison Avenue Bridge will be required. This is because the utilities occupy part of the Herald Street northerly sidewalk which is used for widening Herald Street. The proposed Herald Street retaining wall in the Two Way Herald scheme is directly in line with a new pump station installed just to the south of Washington Street under the Federal Railroad Administration's "Northeast Corridor Improvement Project". This pump station could be bridged over with a small structure. The extension of Herald Street between Clarendon Street and Columbus Avenue under the "One Way Pair" Alternative slices through an existing utility bridge. Because of minimal vertical clearances between the extended Herald Street and the Conrail tracks below, and because of complicated framing requirements, carrying these utilities under Herald Street Extension will be problematical. A possible solution would be to carry these utilities over the roadway within an air-right development supporting Herald Street Extension as discussed in the Structural Review section of the Appendix of this report. The drainage system along most of Herald Street is an older combined system and its replacement with separate drain and sewer lines prior to the reconstruction of Herald Street should be discussed with the utility involved.

## Right-of-Way Considerations

The existing right-of-way of the City of Boston, the Massachusetts Turnpike Authority, Conrail and the MBTA and the required taking are shown on Figures 2A and 2B for the Two Way Herald scheme and Figures 4A and 4B for the One Way Pair scheme.







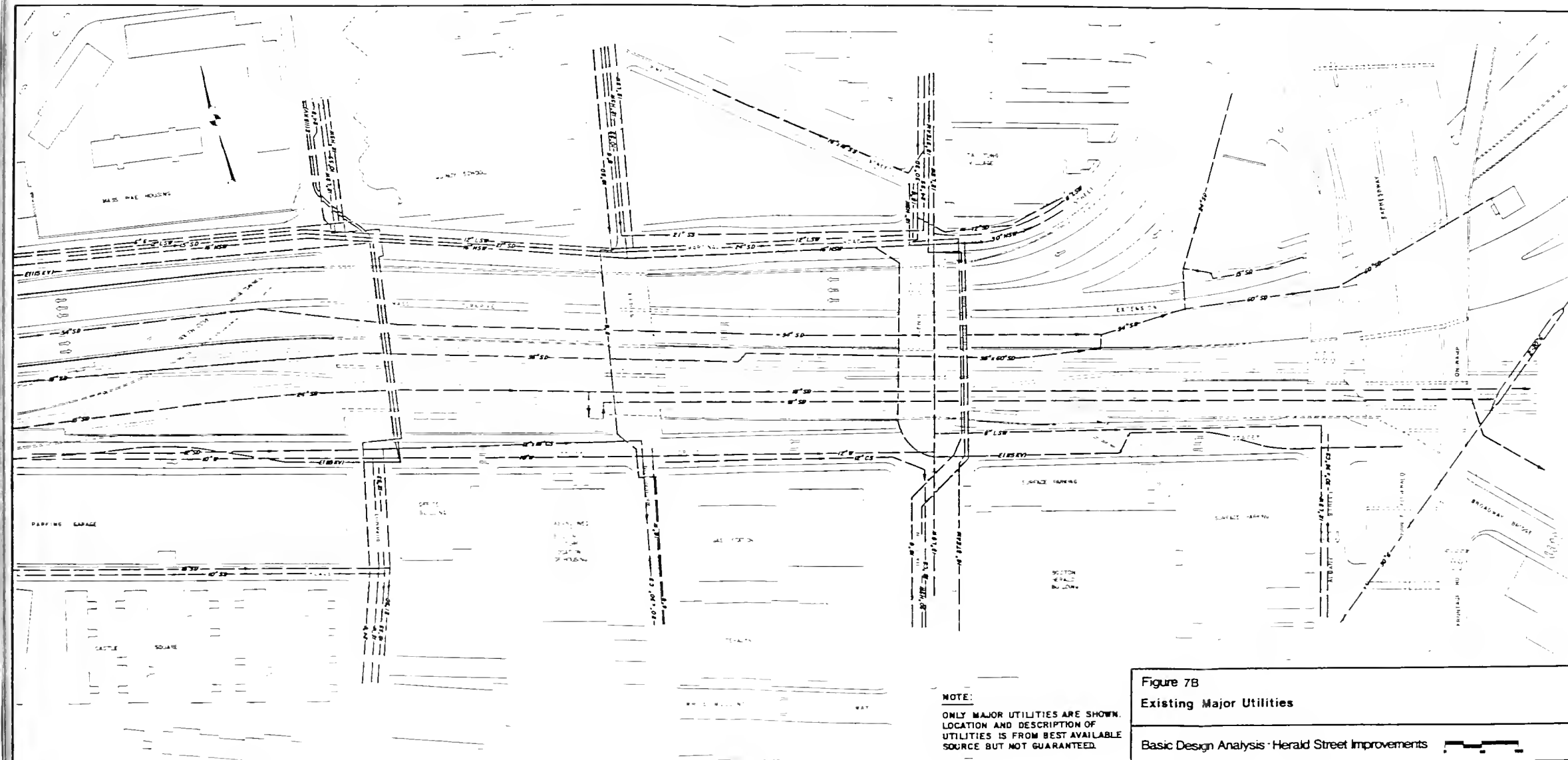
NOTE:  
ONLY MAJOR UTILITIES ARE SHOWN.  
LOCATION AND DESCRIPTION OF  
UTILITIES IS FROM BEST AVAILABLE  
SOURCE BUT NOT GUARANTEED.

Figure 7A  
Existing Major Utilities

Basic Design Analysis - Herald Street Improvements









Under the Two Way Herald scheme, the Herald Street Extension between Columbus Avenue and Arlington Street would require agreements with the Massachusetts Turnpike Authority and the MBTA (to the satisfaction of Conrail and the Federal Railroad Administration) for the use of their air-rights. The widening of Stanhope Street would require a taking (1,400± SF) from the present owner of the parcel bounded by Clarendon Street, Stanhope Street, Cahner Place and the Turnpike. The widening of Herald Street to the north from a point midway between Tremont Street and Shawmut Avenue to beyond Harrison Avenue will require a taking (17,700± SF) from the MBTA (to the satisfaction of the Federal Railroad Administration). Provisions for a right turn lane will require a taking (3,800± SF) from the abutting parcel presently owned by the Boston Herald.

Under the One Way Pair scheme, the Herald Street Extension, the Broadway Extension and possibly Marginal Road Extension will require agreements with the Massachusetts Turnpike Authority and the MBTA for the use of their air-rights. Herald Street between Harrison Avenue and Albany Street will require a taking (3,900± SF) from the MBTA. In addition, the Broadway Extension would require a taking (1,100± SF) from Tai Tung Village (corner of Harrison Avenue and Broadway Extension) and Marginal Road Extension would require a rather large taking or easement (28,600± SF) from the Turnpike Authority.

#### . Traffic Analysis

The measure of the effectiveness of any change in a roadway system is the number of additional vehicles being accommodated and the quality of that accommodation. In planning for any change, the number of vehicles using a facility must be estimated. Historical data, traffic data, changes in land use and, if available, origin and destination information are utilized and expanded to a target year (usually twenty years in the future) to ascertain the number of vehicles that would use a facility under



any set of conditions. Because of the large database required and complexity of the calculations, a computer must be utilized for the traffic assignments. The Central Transportation Planning Staff (CTPS) provided forecasts of the differences that could be expected in the Herald Street corridors for the several alternatives proposed. All traffic predictions assumed the Third Harbor Tunnel and Depressed Central Artery were built and functioning. Basic traffic data was developed from traffic counts furnished by the City of Boston, and from traffic data developed for impact studies of Copley Place, St. James Development and others in the area. All traffic data was expanded to the year 1990 to match the target year figures provided by CTPS. The basic peak hour data and the CTPS differences by alternatives were combined to develop the 1990 Herald Street corridor traffic for each condition. The traffic figures were expanded to represent traffic in the year 2010. A growth factor of less than 1% per year gave a 21 percent growth for the 20-year period to 2010.

Whenever any change in land use or development is proposed, the first transportation alternative always seems to be to do nothing to the existing roadway system. This concept is called the "No Build" alternative and provides a basis for measuring the effectiveness of any proposed changes. The volumes of the motoring public that will be accommodated under each proposal is developed and the Levels of Service provided by each alternative are evaluated to measure the quality of service that will be provided to the drivers that will be serviced by each proposal. A comparison of the several schemes provides a valid measure of the viability of each proposal.

The "No Build" scheme assumes that nothing is done to the roadway system in the Herald Street corridor. The "Two Way Herald" scheme widens and extends Herald Street between Albany Street and Columbus Avenue to provide for two lanes in each direction with an additional right turn lane at Albany Street. The "One Way Pair" scheme provides a three lane eastbound Herald Street





between Albany Street and Clarendon Street and a three lane westbound Marginal Road as an extension of Broadway from Albany Street to Arlington Street with a two lane Marginal Road extension between Arlington Street and Berkeley Street.

A review of the developed traffic figures confirmed that evening peak hour volumes were much greater than those occurring in the morning peak hour. Morning peak hour traffic consists almost entirely of commuters while the evening peak hour traffic includes shoppers and travellers as well as commuters. Because of this, it was decided to analyze the evening peak hour operations at all intersections within the corridor and to investigate the morning peak hour operations only at those locations found critical in the evening peak hour analysis.

The 1985 highway capacity intersection analysis method\* was used to qualify and quantify traffic operations for each of the scenarios. The above mentioned methodology was adapted to personal computer applications by Mr. Daniel Beegan of CTPS and that program was used for the traffic analysis phase of this study. Level of Service is the definition of an intersection's efficiency and is measured by average delay per vehicle passing through the intersection. Table 1 is excerpted from the Highway Capacity Manual to show the evaluation criteria. Definitions and explanation of Level of Service can be found in the appendix. In new design Level of Service C is usually the target. Existing intersections can operate at a D Level of Service to be acceptable.

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\*Special Report 209 "Highway Capacity Manual" Transportation Research Board, Washington, D.C., 1985 Chapters 9 & 10.



TABLE 1

## LEVEL OF SERVICE CRITERIA FOR SIGNALIZED INTERSECTIONS

LEVEL OF SERVICE	STOPPED DELAY PER VEHICLE (SEC)
A	5.0 or Less
B	5.1 to 15.0
C	15.1 to 25.0 - <i>15.1 to 25.0</i>
D	25.1 to 40.0 - <i>25.1 to 40.0</i>
E	40.1 to 60.0
F	Greater than 60.0

Table 2 is a presentation of the result of the analyses of the 2010 PM Peak Hour by intersection and by alternative. A comparison of vehicle volumes assigned to the Albany Street terminus of the analysis area reveals that the traffic demand increases from 3,513 vehicles for the "No Build" to 3,959 vehicles for the "Two Way Herald" to 4,232 vehicles for the "One Way Pair," a total increase of over 700 vehicles (20 percent).

The table also reveals that two intersections in the "No Build" alternative, Herald Street at Albany Street and Broadway and Herald Street at Harrison Avenue, will operate at an unacceptable Level of Service. The remainder of the existing intersections will be at a "C" Level of Service or better.

Results of the analysis of the Two Way Herald scheme identify five (5) intersections that could be expected to operate at an "F" Level of Service. This was not unexpected as the widening and extension of Herald Street to Columbus Avenue added two lanes



of westbound traffic to the corridor between Washington Street and Columbus Avenue and added two lanes of eastbound traffic between Columbus Avenue and Tremont Street. Very little was possible to mitigate the adverse impacts as the new roadway width was controlled by the location of the Herald Street/Railroad retaining wall. The traffic signal programs were optimized to obtain the best possible Level of Service and the results are shown on the table.

Analysis of the One Way Pair scheme resulted in the best operation for the greatest number of vehicles. Two intersections were analyzed to operate at an "F" Level of Service under this scheme. The Herald Street - Arlington Street - Tremont Street intersection was improved to a "D" Level of Service by adding a right turn lane to the northbound Tremont Street approach and a third lane to the eastbound Herald Street approach. These recommended mitigating measures reduce the average delay per vehicle from 84.2 seconds to 36.1 seconds per vehicle and are shown as an option on Figure 4A.

The remaining intersection that would operate at an "F" Level of Service was the Clarendon Street - Columbus Avenue location. The two lane Herald Street extension terminating at Columbus Avenue requires that a very heavy left turn must be accommodated out of Clarendon Street. By providing a direct three lane connection between Clarendon Street and the Herald Street Extension, the operation can be improved to a "B" Level of Service at both locations. This connection is recommended and is shown as an option on Figure 4A.

The totals and averages provided at the bottom of Table 2 show the total number of vehicles that would go through the intersections of the Herald Street corridor. The "No Build" alternative will service almost 27,100 vehicles with an average delay of 50.3 seconds per vehicle. This is slightly misleading in that the greater part of the delay occurs at two intersections. The



TABLE 2  
2010 PM PEAK HOUR CAPACITY  
ANALYSIS RESULTS

ALTERNATIVE INTERSECTION	NO BUILD				TWO WAY HERALD STREET				ONE WAY PAIR			
	Volume Vehicle	Level of Service	Avg. Delay (Seconds)	Total Delay Vehicle Hrs.	Volume Vehicle	Level of Service	Avg. Delay (Seconds)	Total Delay Vehicle Hrs.	Volume Vehicle	Level of Service	Avg. Delay (Seconds)	Total Delay Vehicle Hour
HERALD ST. @ ALBANY ST. & BROADWAY	3513	(F)	289.9	283.4	3959	(F)	152.0	167.2	3386	C	21.4	20.1
HERALD ST. @ HARRISON AVE.	2885	(E)	50.1	40.1	3261	B	14.7	13.3	846 (free RT)	B	13.1	9.9
HERALD ST. @ WASHINGTON ST.	3318	B	14.1	13.0	3831	(F)	129.4	137.7	2940	B	14.1	11.5
HERALD ST. @ SHAMMUT AVE.	2364	C	21.8	14.3	3992	(F)	64.7	71.7	2885	B	13.0	10.4
HERALD ST. @ ARLINGTON ST. & TREMONT ST.	2497	B	13.3	9.2	3982	(F)	329.8	365.3	3892 (F)	(F)	84.2	91.0
HERALD ST. @ ARLINGTON ST. RT. TURN LANE ADDED					3982	(F)	293.1	324.6	3892 **	D	36.1	39.0
HERALD ST. @ BERKELEY ST.					2385	B	9.3	6.2	1617	B	10.0	4.5
HERALD ST. @ COLUMBUS AVE.					2159	C	16.3	9.8	2954	B	13.3	10.9
COLUMBUS AVE. @ CLARENDON ST. WITH DIR. CONN. TO HERALD ST.	2621	B	13.7	10.0	3865	(F)	296.5	318.3	3532 (F)	(F)	255.6	250.8
COLUMBUS AVE. @ BERKELEY ST.	1919	B	11.0	5.9	2596	B	14.3	10.3	2899	B	14.8	11.9
MARGINAL RD. (CORIES ST.) @ BERKELEY ST.	874	C	15.8	3.8	1049	A	1.9	0.6	1258	B	14.1	4.9
MARGINAL RD. @ ARLINGTON ST.	2410	B	12.7	8.5	1642	B	10.1	4.6	2580	C	15.7	13.0
MARGINAL RD. @ TREMONT ST.	1222	B	9.2	3.1	751	B	9.1	1.9	2691	B	8.6	6.4
MARGINAL RD. @ SHAMMUT AVE.	1500	B	11.4	4.8	931	B	8.8	2.3	3013	B	12.0	10.0
MARGINAL RD. @ WASHINGTON ST.	1207	B	6.1	2.0	963	B	6.9	1.8	2089	B	9.7	5.6
MARGINAL RD. @ HARRISON AVE.	766	A	5.1	1.1	718	B	14.8	3.0	2504	C	17.2	12.0
TOTALS & AVERAGES*	27096	E	50.4	379.2	36089	F	107.1	1073.3	40698	C	15.4	174.6

\*ONLY MITIGATED VOLUMES INCLUDED WHERE POSSIBLE

NOTE: UNDERLINED VOLUMES = UNACCEPTABLE LOS

\*\* LANE ADD EB HERALD ST. ALSO



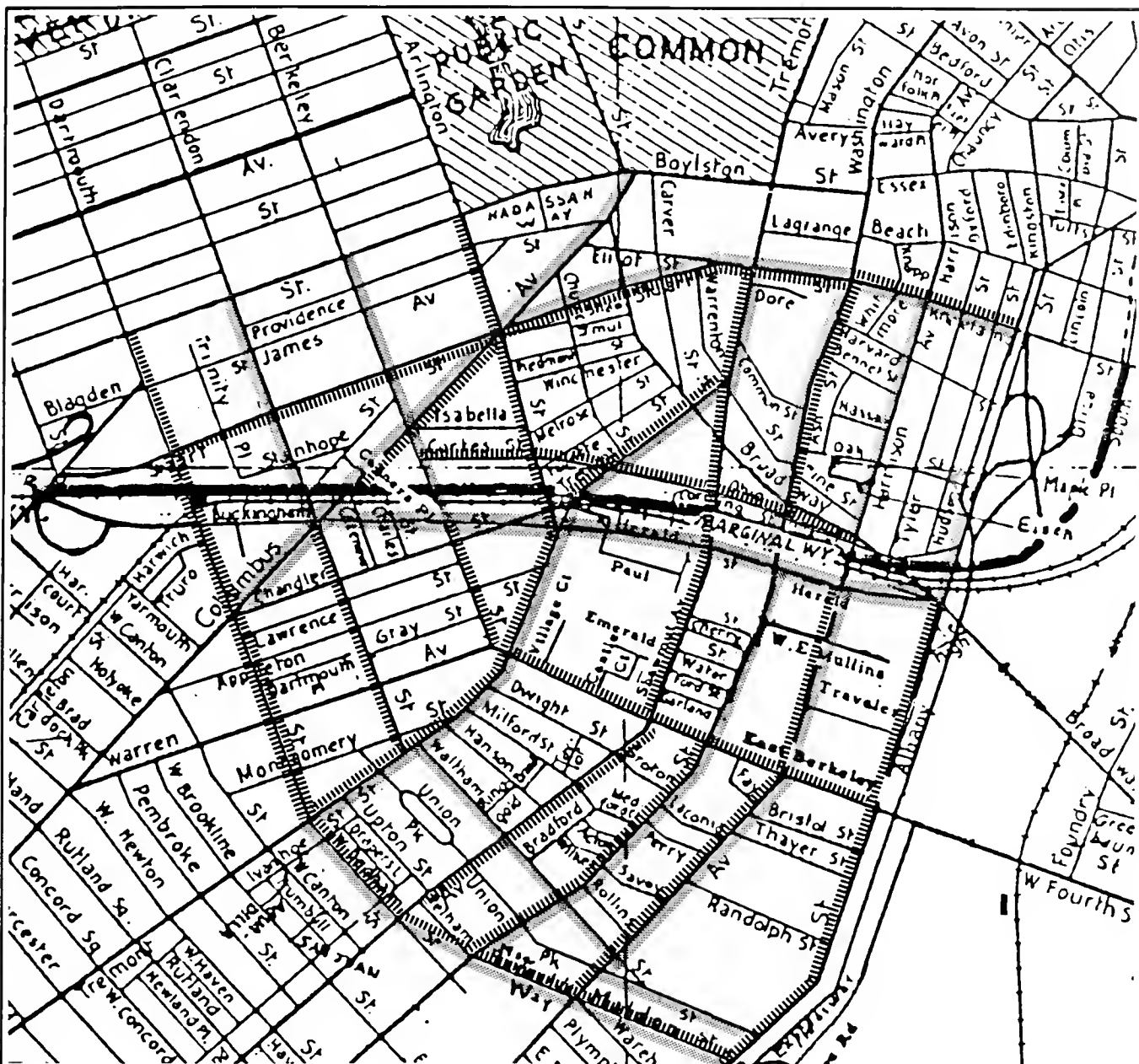


Two Way Herald scheme services almost 36,100 vehicles, but because of the many left turn conflicts introduced into the system, the average delay per vehicle is 106.1 seconds per vehicle, more than double the average delay generated under the "No Build" alternative. As can be readily seen, the most efficient of the two improvement schemes is the One Way Pair. The 40,700 vehicles are accommodated with an average delay of under 16 seconds per vehicle. The build schemes are not directly comparable to the "No Build" analysis results because two new intersections are introduced in the build proposals. In spite of that discrepancy it can be seen that improving the Herald Street corridor will service more vehicles and the One Way pair will provide that service much more efficiently.

Analysis of the CTPS traffic flow assignments for the several arterials in the Herald Street corridor quantified the effects of the two improvement alternatives. Figures 8 and 9 present the estimated AM and PM Peak traffic flow changes that are generated by the Two Way Herald Alternative as compared to the No Build alternative. Figures 10 and 11 present the same information for the One Way Pair alternative. It is interesting to note that in most instances the arterials to and from the expressway system (excluding Marginal Road and Herald Street) experience a reduction while the arterials to and from the downtown increase over the No Build alternative. Under both alternatives, the Columbus Avenue-Tremont Street corridor experiences an increase in traffic flow. This is probably due to the fact that Herald Street is so greatly improved and this corridor provides the best access to the new facility.

Table 3 is a presentation of the magnitude of the estimated change generated by each alternative by facility segments. Based upon the results of the capacity analysis and this traffic flow analysis, the One Way Pair alternative will provide the best access and circulation in and through the study area.





Increased Traffic Flow

No Change or Decreased Traffic Flow

NOTE:  
SIDE OF STREET SYMBOLIZATION REPRESENTS  
NORMAL TRAFFIC FLOW DIRECTION.  
FOR MAGNITUDE OF CHANGE SEE TABLE 3.

x Hudson  
x Harrison

**Figure 8**  
**TWO WAY HERALD AM PEAK HOUR**  
**TRAFFIC DIFFERENCES AS COMPARED TO NO BUILD**

Basic Design Analysis - Herald Street Improvements

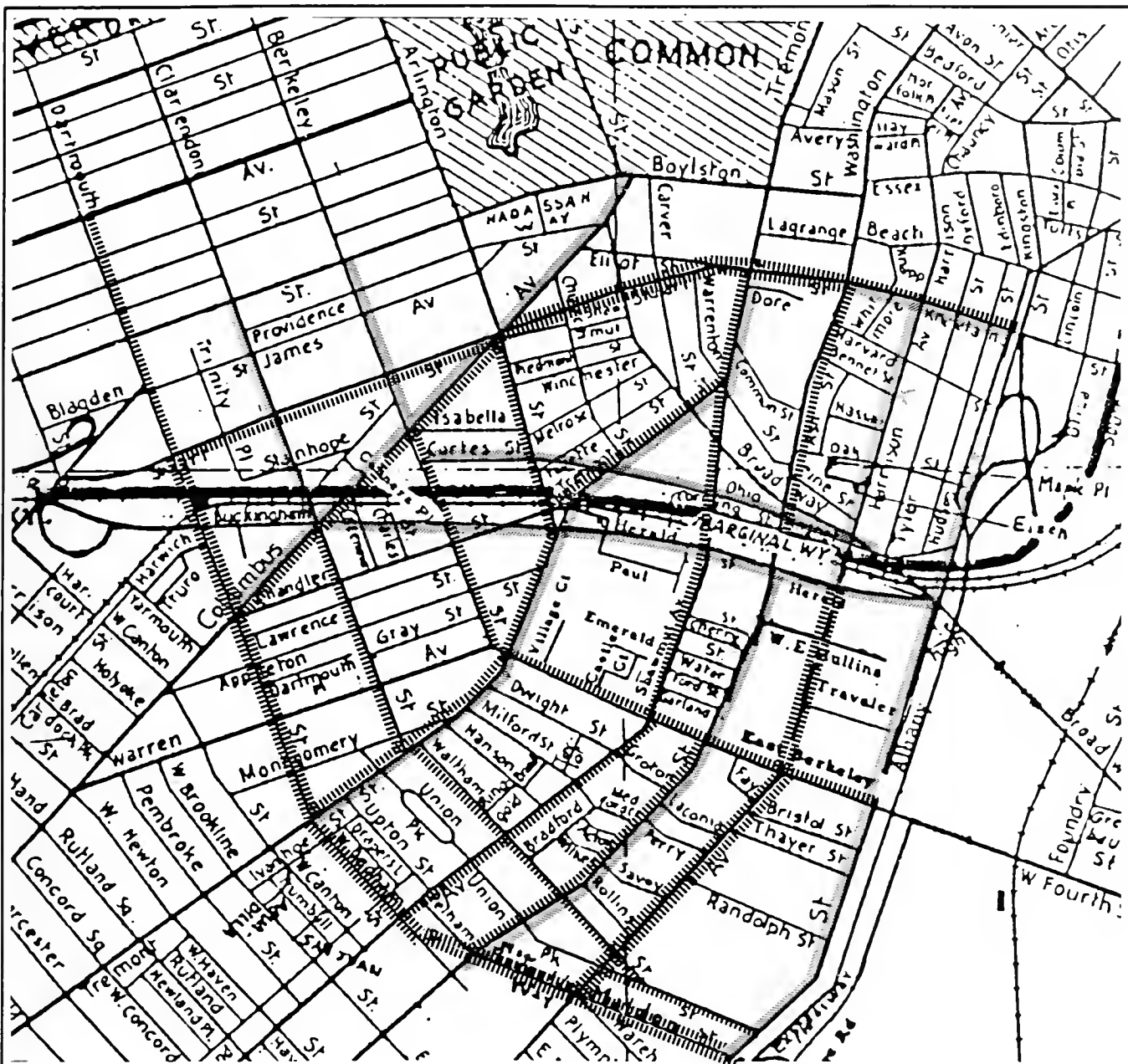
0 400 800 1200 FT.











————— Increased Traffic Flow

----- No Change or Decreased Traffic Flow

NOTE:  
SIDE OF STREET SYMBOLIZATION REPRESENTS  
NORMAL TRAFFIC FLOW DIRECTION.  
FOR MAGNITUDE OF CHANGE SEE TABLE 3.

*X Hudson*  
*X Hamilton*

**Figure 10**  
**ONE WAY PAIR AM PEAK HOUR**  
**TRAFFIC DIFFERENCES AS COMPARED TO NO BUILD**

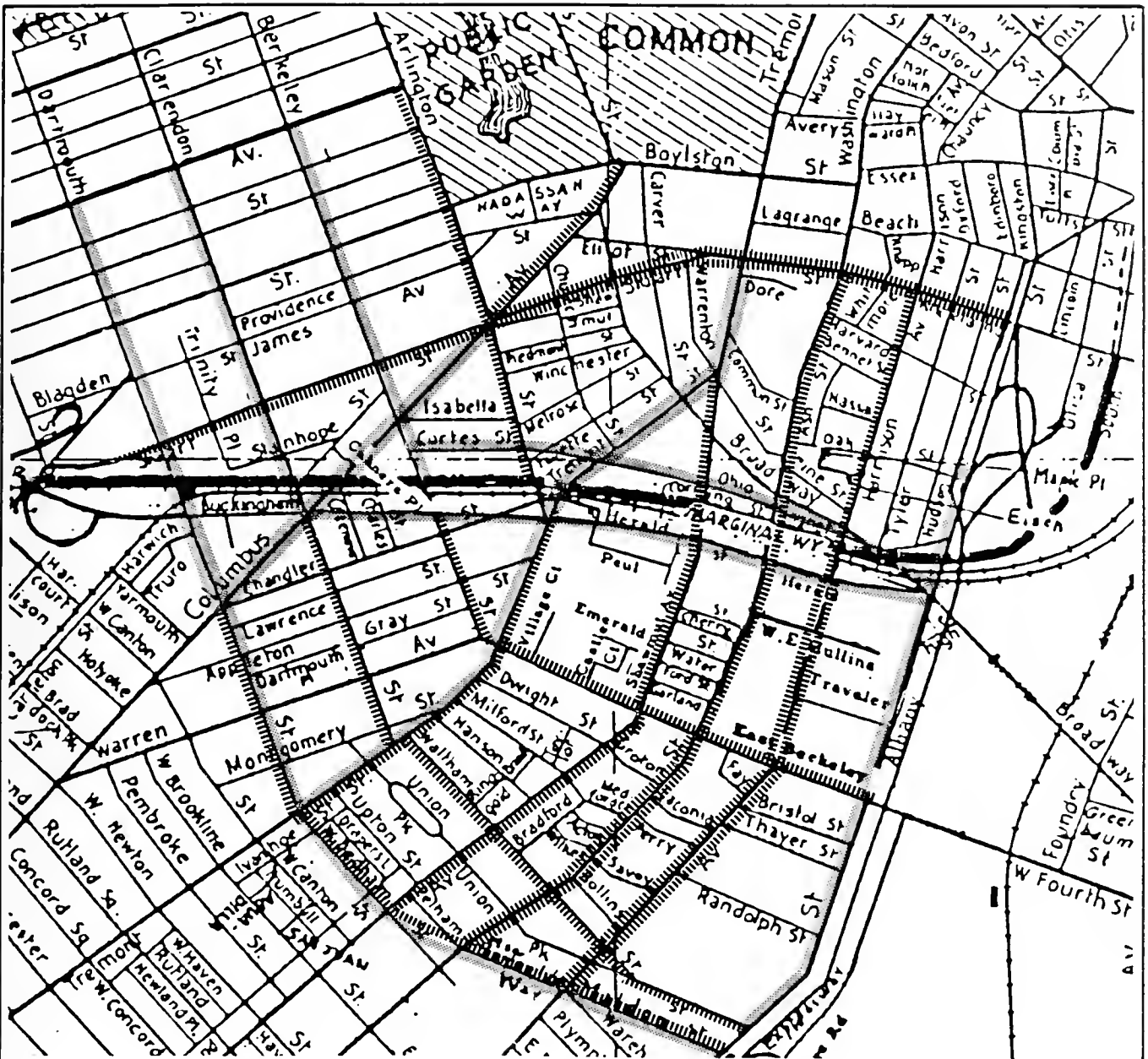
Basic Design Analysis – Herald Street Improvements

0 400 800 1200 FT.









Increased Traffic Flow

No Change or Decreased Traffic Flow

NOTE:  
SIDE OF STREET SYMBOLIZATION REPRESENTS  
NORMAL TRAFFIC FLOW DIRECTION.  
FOR MAGNITUDE OF CHANGE SEE TABLE 3.

**Figure 11**  
**ONE WAY PAIR PM PEAK HOUR**  
**TRAFFIC DIFFERENCES AS COMPARED TO NO BUILD**

Basic Design Analysis - Herald Street Improvements

0 400 800 1200 FT.





TABLE 3

AVERAGE PERCENT CHANGE\*  
HERALD STREET CORRIDOR ARTERIAL TRAFFIC VOLUMES  
COMPARED TO "NO BUILD" ALTERNATIVE

ROADWAY		LIMITS		TWO WAY HERALD		ONE WAY PAIR	
Flow	Direction	From	To	% Change Morning Peak	% Change Evening Peak	% Change Morning Peak	% Change Evening Peak
SOUTHBOUND EXPRESSWAY OFF RAMP							
	SOUTH	EXPRESSWAY	HERALD ST.	3.3%	7.4%	5.4%	31.3%
* ALBANY STREET							
	SOUTH	HERALD ST.	BERKELEY ST.	0	12.5%	5.1%	11.3%
	SOUTH	BERKELEY ST.	W. DEHAM ST.	-8.0%	5.1%	0.8%	17.2%
ARLINGTON STREET							
	SOUTH	BOYLSTON ST.	COLUMBUS AVE.	-12.8%	-26.2%	-10.8%	-19.6%
	SOUTH	COLUMBUS AVE.	HERALD ST.	-31.4%	-27.7%	-41.9%	-10.1%
BERKELEY STREET							
	NORTHWEST	ALBANY ST.	TREMONT ST.	-10.7%	-23.2%	-29.5%	-43.6%
	NORTH	TREMONT ST.	HERALD ST.	-21.7%	-32.6%	-29.1%	-29.5%
	NORTH	HERALD ST.	COLUMBUS AVE.	42.6%	94.8%	----	----
	NORTH	COLUMBUS AVE.	BOYLSTON ST.	7.6%	5.8%	20.5%	16.4%
CLARENDON STREET							
	SOUTH	BOYLSTON ST.	COLUMBUS AVE.	66.3%	25.2%	140.7%	30.9%
	SOUTH	COLUMBUS AVE.	TREMONT ST.	-16.5%	-27.4%	-20.6%	-29.6%
* COLUMBUS AVE.							
	NORTHEAST	DARTMOUTH ST.	HERALD ST.	41.8%	180.1%	-1.1%	46.5%
	NORTHEAST	HERALD ST.	ARLINGTON ST.	-34.1%	12.0%	-26.9%	4.5%
	SOUTHWEST	CHARLES ST.	ARLINGTON ST.	67.3%	25.7%	53.5%	-11.9%
	SOUTHWEST	ARLINGTON ST.	HERALD ST.	15.1%	38.4%	52.1%	21.4%
	SOUTHWEST	HERALD ST.	DARTMOUTH ST.	58.1%	3.9%	63.4%	7.9%
CORTES STREET (MARGINAL RD. EXT.)							
	WEST	ARLINGTON ST.	BERKELEY ST.	0	25.9%	783.5%	122.6%
DARTMOUTH STREET							
	SOUTH	STUART ST.	COLUMBUS AVE.	-21.1%	5.7%	-10.9%	2.2%
	SOUTH	COLUMBUS AVE.	TREMONT ST.	-13.0%	-2.8%	-6.3%	-1.7%
	NORTH	TREMONT ST.	COLUMBUS AVE.	-13.7%	-14.8%	-6.2%	12.5%
	NORTH	COLUMBUS AVE.	BOYLSTON ST.	-7.9%	0	-9.1%	0
WEST DEOHAM STREET							
	SOUTH	TREMONT ST.	ALBANY ST.	3.9%	0.3%	-36.9%	10.0%
	NORTH	ALBANY ST.	TREMONT ST.	-8.6%	-19.4%	-3.5%	-19.4%
* HARRISON AVE.							
	SOUTH	WHEELAND ST.	MARGINAL RD.	64.1%	127.0%	307.7%	0
	SOUTH	HERALD ST.	W. DEOHAM ST.	-3.1%	-11.1%	-1.1%	-17.4%
	NORTH	W. DEOHAM ST.	HERALD ST.	4.7%	1.2%	-54.0%	-4.1%

\* Since the computer program used to develop the base traffic projections was calibrated for the east/west directional flows only, the north/south traffic projections, and consequently the north/south "Average Percent Change" could be less accurate than the east/west. Calibration in both directions is very time consuming and was deemed unnecessary to develop traffic projections for Herald Street and its parallel roadways, the main thrust of the analysis.



TABLE 3 (continued)  
AVERAGE PERCENT CHANGE\*  
HERALD STREET CORRIDOR ARTERIAL TRAFFIC VOLUMES  
COMPARED TO "NO BUILD" ALTERNATIVE

ROADWAY	Flow Direction	LIMITS		TWO WAY HERALD		ONE WAY PAIR	
		From	To	% Change Morning Peak	% Change Evening Peak	% Change Morning Peak	% Change Evening Peak
HERALD STREET	WEST	ALBANY ST.	WASHINGTON ST.	57.8%	49.3%	---	---
	WEST	WASHINGTON ST.	TRENT ST.	---	---	---	---
	WEST	TRENT ST.	COLUMBUS AVE.	---	---	---	---
	EAST	COLUMBUS AVE.	TRENT ST.	---	---	---	---
	EAST	TRENT ST.	ALBANY ST.	4.6%	0	27.9%	19.5%
KNEELAND STREET	WEST	SURFACE ARTERY	WASHINGTON ST.	0.8%	-8.5%	-3.3%	-6.3%
	EAST	WASHINGTON ST.	SURFACE ARTERY	1.0%	-0.6%	4.2%	-2.1%
MARGINAL ROAD	WEST	HARRISON AVE.	WASHINGTON ST.	-63.2%	0	560.8%	---
	WEST	WASHINGTON ST.	TRENT ST.	-74.3%	-3.8%	66.3%	171.5%
	WEST	TRENT ST.	ARLINGTON ST.	-27.0%	-6.6%	218.3%	77.2%
	WEST	ARLINGTON ST.	HERALD ST.	-17.0%	-6.4%	-3.6%	-11.8%
SHAWMUT AVE.	SOUTH	STUART ST.	BERKELEY ST.	0	-74.8%	0	0
	SOUTH	BERKELEY ST.	BERKELEY ST.	-3.7%	0	0	0
	NORTH	DARTMOUTH ST.	ARLINGTON ST.	5.0%	-8.2%	0.9%	-11.6%
STUART STREET	EAST	DARTMOUTH ST.	ARLINGTON ST.	-8.3%	-0.8%	-16.2%	-11.5%
	EAST	ARLINGTON ST.	WASHINGTON ST.	-1.2%	1.2%	2.2%	-9.5%
	EAST	WASHINGTON ST.	HERALD ST.	1.7%	-51.1%	2.8%	-37.1%
TRENT STREET	NORTH	HERALD ST.	OK ST.	16.6%	22.8%	19.4%	143.1%
	SOUTH	STUART ST.	HERALD ST.	-7.8%	-14.6%	-0.9%	11.4%
	SOUTH	HERALD ST.	DARTMOUTH ST.	-17.1%	46.4%	-24.2%	52.8%
	SOUTH	TRENT ST.	ALBANY ST.	5.6%	-1.1%	-12.5%	-10.8%
WASHINGTON STREET	NORTH	DARTMOUTH ST.	BERKELEY ST.	3.3%	-0.2%	3.4%	-20.7%
	NORTH	BERKELEY ST.	HERALD ST.	2.8%	1.0%	22.0%	-28.1%
	NORTH	HERALD ST.	KNEELAND ST.	-9.0%	-34.7%	-11.4%	-29.6%
	SOUTH	BERKELEY ST.	DARTMOUTH ST.	0	-5.5%	-17.1%	-19.6%

\* Since the computer program used to develop the base traffic projections was calibrated for the east/west directional flows only, the north/south traffic projections, and consequently the north/south "Average Percent Change" could be less accurate than the east/west. Calibration in both directions is very time consuming and was deemed unnecessary to develop traffic projections for Herald Street and its parallel roadways, the main thrust of the analysis.



Cost Analysis

Order-of-magnitude construction cost for the One Way Pair and the Two Way Herald schemes have been developed and are as follows:

	<u>CONSTRUCTION COST</u>	
	TWO WAY	ONE WAY
	<u>HERALD</u>	<u>PAIR</u>
Bridges & Walls	10,000,000	10,700,000
Roadways	<u>1,600,000</u>	<u>2,700,000</u>
TOTAL	\$11,600,000	\$13,400,000*

These costs are in 1986 dollars and do not include design costs, land taking costs, air-right costs or the cost of improving the water and sewer systems in the affected roadways. The figures assume full depth reconstruction of Herald Street, an overlay of Marginal Road and new lighting and landscaping throughout. The cost of bridge and wall work adjacent to or over the railroad or Turnpike was increased significantly to compensate for restrictions these facilities will impose on construction. The Two Way Herald scheme required the taking of approximately 22,900 SF of land. The One Way Pair scheme requires the taking of approximately 33,600 SF of land. The majority of the taking are from the MBTA and the Turnpike Authority.

\*\$16,700,000 with recommended options a) Herald Street Extension, Clarendon Street to Columbus Avenue (Alternate A) and b) approach widening at intersection of Herald, Arlington and Tremont Streets.





## Air-Rights Development

In addition to traffic impacts and construction costs, the two alternatives must be evaluated for their effects on potential air-rights development in the abutting turnpike/railroad corridor. The alternative selected should be compatible with the BRA's long-term air-rights development objectives.

One way street patterns provide better access to abutting land uses if cross streets are frequent enough to ensure good circulation. Two way streets generate conflicts with opposing traffic thus making driveway access difficult. In the Two Way Herald scheme, access to the air-rights developments should be restricted to Marginal Road, Cortes Street and the cross streets. The One Way Pair provides better circulation and the best Level of Service for the corridor (see Traffic Analysis) and, therefore, less congestion in the area.

Because of the Herald Street Extension alignment between Columbus Avenue and Berkeley Street in the Two Way Herald scheme, less space is available for development in the block bounded by Columbus Avenue, Berkeley Street and the Amtrak rails. Under the One Way Pair scheme, the Herald Street Extension occupies much of the potential development space in the block bounded by Columbus Avenue, Clarendon Street, Stanhope Street and Cahner Place. In this block, serious consideration should be given to constructing the Herald Street Extension within and as part of an air-rights development. This will help solve the engineering problems associated with this roadway, reduce its cost and leave the entire parcel open for development.

Under the Two Way Herald scheme, Herald Street is two lanes in each direction with no provisions for parking or standing. This is acceptable under the conditions of the area today, that is,



under-developed with little demand for stopping and parking. If and when the area is developed there will be a desire for vehicles to stop along Herald Street. Parking restrictions along Herald Street would have to be enforced otherwise this roadway would be reduced to one lane in each direction. Under the One Way Pair scheme Herald Street and Marginal Road are three lanes in each direction. Parking could possibly be allowed in certain areas during the off peak.

In both schemes certain areas required for supports for viaducts or retaining walls may also be required for support of future possible air-rights development. In some areas supports for air-rights can be added without significantly interfering with the supports for the roadway. In other areas, the walls for the roadways would have to be replaced with ones capable of supporting the air-rights development and the roadway. This would require rebuilding part of the roadway as well. This replacement could be avoided by designing any new walls to support the future air-rights development. This raises questions such as which blocks will be developed, what amount of additional support will be required for the development and how will this additional support be funded?

#### Summary

The One Way Pair scheme will provide the best access and circulation of traffic movements in and through the study area. The Two Way Herald scheme services more vehicles than a No Build scheme, however, the average delay per vehicle per intersection is increased. The One Way Pair scheme services more vehicles while reducing the average delay per vehicle per intersection.



	<u>No Build</u>	<u>Two Way Herald</u>	<u>One Way Pair</u>
Vehicles Served (Corridor)	27,100	36,100	40,700
Ave. Delay Per Vehicle Per Intersection (Sec)	50	106	16
Intersections at Level of Service F	2	5	2*

The one way street patterns set up by the One Way Pair scheme eliminates left turn conflicts at most intersections thereby increasing the capacity of the system and reducing delays.

Future air rights can be developed under both schemes, however their construction will be somewhat simpler in some areas under the One Way Pair. The One Way Pair provides better access to the developments. Access to any future air rights under the Two Way Herald scheme should probably be restricted to Marginal Road. The estimated construction cost of the Two Way Herald scheme in 1986 dollars, is \$11,600,000. The estimated construction cost of the One Way Pair scheme is \$13,400,000 (\$16,700,000 with recommended improvements at the Clarendon Street, Columbus Avenue and Herald Street, Arlington Street Intersections).

\* Zero with recommended improvements at the Clarendon/Columbus and Herald/Arlington intersections.



## APPENDIX

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- ° Design Criteria
- ° Structural Review
- ° Level of Service for Signalized Intersections
- ° Intersection Capacity Analysis





## APPENDIX

### . Design Criteria

The parameters to be used for the design of the new roadways are summarized hereafter. Many of these parameters are from AASHTO's "Geometric Design of Highways and Streets" 1984 and assume roadway classification of "Urban Minor Arterial Street".

#### I. Roadway Construction

1. 11' wide travel lanes
2. 1' curb offsets
3. 10' parking lanes
4. Sidewalks: 10' desired, 8' minimum
5. Vertical granite curbing at both edges of roadway

#### II. Design Speed: 30 M.P.H.

#### III. Maximum Grade: 8%

#### IV. Cross-Slope: 2% to both gutters, rounded in the center

#### V. Horizontal Alignment

1. Minimum Radius: 325 ft.
2. Maximum Superelevation: 0.04 ft./ft.
3. Superelevation Runoff: 65 ft. (2-lane roadway)  
80 ft. (3-lane roadway)
4. Minimum Stopping Sight Distance: 200ft.
5. Minimum Horizontal Clearance of Turnpike: 2'-0"



6. Minimum Horizontal Clearance of MBTA: 8'-6"\* minimum from Centerline of Tracks.
7. Minimum Horizontal Clearance of Amtrak (MBTA Commuter Rail): 8'-6"\*\* from Centerline of Tracks.

#### VI. Vertical Alignment

1. Minimum Vertical Stopping Sight Distance: 200 ft.
2. Minimum Length of Crest Curve:  $28 \times A^{***}$
3. Minimum Length of Sag Curve:  $36 \times A^{***}$
4. Minimum Vert. Clearance of Turnpike Roadway: 14'-6"
5. Minimum Vert. Clearance of M.B.T.A. Rail: 15'-0"
6. Minimum Vert. Clearance of Amtrak (MBTA Commuter Rail): 16'-5"
7. Minimum Vert. Clearance of Conrail: 16'-4"

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\*6'-6" at spot locations with MBTA approval.

\*\*On Straight track; 7'-6" with variance.

\*\*\*A is the algebraic difference in grades expressed as a percent.



## . Structural Review

The Turnpike/Railroad corridor between Clarendon Street and Albany Street is bounded by buildings and Herald Street on the south and Cortes Street, Marginal Road and Hudson Street on the north. The area available for new supporting elements is limited to the locations outlined in the Support Locations - Horizontal Clearances section of this report and as described hereinafter.

Between Clarendon Street and Columbus Avenue the Southwest Corridor Project has resulted in the construction of new walls between the Amtrak and MBTA Orange Lines (the Center Wall) and between the MBTA Orange Line and the Conrail Lines (the Transit Wall). It is our understanding that these walls were not designed to carry the additional load of an extended Herald Street as shown on Figure 4A. Herald Street extension between Clarendon Street and Columbus Avenue (Alternates A and B only) would require the replacement of the new "Transit Wall" and probably the replacement of the new station entrance which is supported on top of it. The Herald Street Extension in this block would also require new supports between the Conrail tracks and eastbound Turnpike roadway, the Turnpike median and along the northerly wall of the westbound Turnpikes thereby reducing the development potential of the parcel. This extensive work, especially the replacement of the "Transit Wall" would be costly and difficult, but may be more justified if included within an air-right development of this block. The building could cover most of the block and Herald Street Extension could possibly be suspended within it.

Between Columbus Avenue and Tremont Street the two walls lining either side of the relocated MBTA Orange Line are both low walls designed to support traffic loads from an extended Herald Street. The wall between the Amtrak lines and the MBTA Orange Line is



called the Center Wall, and the wall between the Orange Line and Conrail is called the Transit Wall. The Center Wall supports a platform canopy between Columbus Avenue and Berkeley Street. This canopy would have to be removed, revised, or circumvented by the new Herald Street supports. Just to the west of Berkeley Street there is an electric substation over the southerly three Amtrak/Commuter Rail tracks. The Center Wall support has a shelf on the north side to support beams for the Herald Street extension. Under the Two Way Herald scheme supports would have to be placed between the Conrail tracks and the Turnpike (see Figure 3, Section E-E). Here allowances may have to be made for a future lowering of the Conrail tracks with a watertight invert slab, as was done for the Southwest Corridor Project. The Conrail tracks would have to remain operational during the construction of new foundations, as would the Turnpike.

The Columbus Avenue and Arlington Street/Tremont Street bridges cross the tracks and the Turnpike at a skew. Support of the Herald Street Extension or any other air-rights structure would be difficult in the triangular area between these bridges and a line perpendicular to the tracks. Framing would be difficult and the area for support would disappear in the vicinity of the triangle's apex. Under the Two Way Herald scheme a curve at the west end of the proposed Herald Street would require framing across Conrail tracks and the Turnpike, well beyond the proposed roadway limits.

Between Shawmut Avenue and Washington Street there is a 20' to 30' wide strip in front of the Herald Street retaining wall in which foundations may be placed for the Herald Street widening under the Two Way Herald scheme. Herald Street may be widened by constructing a new retaining wall at the back edge of sidewalk and filling the space between the new and existing walls with





gravel (see Figure 3, Section F-F). Preventive measures must be taken during construction to ensure that this newly placed fill will not settle over a long period, resulting in a continuing maintenance problem. Just to the south of Washington Street the new wall is in line with an existing pump station recently installed under the Federal Railroad Administrations "Northeast Corridor Improvement Project". This pump station would probably be bridged over with a short structure. Because of the requirement to meet the grades at each of the existing bridges that cross the Railroad, Turnpike corridor, widening Herald Street northerly will require a higher profile for the Herald Street northerly gutter thereby increasing the load on the existing retaining wall. If the wall is not overstressed due to this additional fill, an alternate method for supporting widened Herald Street would be to construct columns, longitudinal beams and a reinforced concrete slab which would span from the beams to the existing wall. Where the widening results in a 3' or less extension beyond the exposed face of the existing retaining wall, consideration should be given to canterlevering a reinforced concrete slab off the existing wall. An existing utility bridge at Harrison Avenue will have to be modified or replaced because of widening under the Two Way Herald scheme. The extent of the work required at the utility bridge requires further study.

If Herald Street is widened northerly between Harrison Avenue and Albany Street (Two Way Herald only) a portion (if not all) of the old Broadway Street Bridge will have to be removed, including the two billboards currently supported by this structure. Any widening of Herald Street in the southerly direction (two Way Herald only) will require reconstruction of the southerly portion of the bridge spanning the railroad spur line serving the Herald Newspaper plant.









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